

IN THE CLAIMS

Please amend the claims as follows:

1. (Currently Amended) A parallel-channel ~~two-channel~~ frequency-offset estimator to generate a frequency offset estimate comprising:

a first autocorrelation element to perform a first autocorrelation on a serial symbol stream of training symbols delayed by a first duration to produce a first correlation output;

a second autocorrelation element to perform a second autocorrelation on the serial symbol stream delayed by a second duration to produce a second correlation output;

a first moving average element to perform a first moving average on the first correlation output for use in generating a first phase shift estimate; and

a second moving average element to perform a second moving average on the second correlation output for use in generating a second phase shift estimate,

wherein the autocorrelation elements perform autocorrelations on differently delayed versions of the same serial symbol stream, and

wherein the first and second durations are differing integer multiples of symbol durations,
and

wherein the first and second moving averages are different and based on the first and second durations, respectively.

2. (Original) The frequency-offset estimator of claim 1 wherein the frequency offset estimate is a fine frequency offset estimate and is applied to a phase rotator to rotate the phase of data symbols of an orthogonal frequency division multiplexed (OFDM) packet prior to performing a Fast Fourier Transform (FFT).

3. (Original) The frequency-offset estimator of claim 1 wherein the first duration is a duration of one of the training symbols, and the second duration is twice the first duration, and wherein the first moving average element performs the first moving average over approximately

one and a half durations, and the second moving average element performs the second moving average over approximately one-half durations on the second correlation output.

4. (Original) The frequency-offset estimator of claim 1 further comprising a phase correction element to adjust the second phase shift estimate by a multiple of 2π when a difference between the first and second phase shift estimates exceed π .

5. (Currently Amended) A two-channel frequency-offset estimator to generate a frequency offset estimate comprising:

a first autocorrelation element to perform a first autocorrelation on a serial symbol stream of training symbols delayed by a first duration to produce a first correlation output;

a second autocorrelation element to perform a second autocorrelation on the serial symbol stream delayed by a second duration to produce a second correlation output;

a first moving average element to perform a first moving average on the first correlation output for use in generating a first phase shift estimate;

a second moving average element to perform a second moving average on the second correlation output for use in generating a second phase shift estimate; and

~~The frequency offset estimator of claim 1 further comprising~~ a summator to combine the first and second phase shift estimates to generate a frequency offset estimate, wherein the summator multiplies the first phase shift estimate by $w_1/2\pi T$ to generate a first weighted frequency estimate, and multiplies the second phase shift estimate by $w_2/4\pi T$ to generate a second weighted frequency estimate, and combines the first and second weighted frequency estimates to generate the frequency offset estimate, wherein w_1 and w_2 are weights and T is the duration.

6. (Original) The frequency-offset estimator of claim 4 wherein the frequency offset estimate is applied to a phase rotator to shift a phase of symbols of an orthogonal frequency division multiplexed (OFDM) packet prior to performing a Fast Fourier Transform (FFT), the phase shift being held constant for performing the FFT on subsequent data symbols of the OFDM packet.

7. (Original) The frequency-offset estimator of claim 1 wherein the training symbols are sampled long training symbols comprised of a plurality of modulated subcarriers having known training values.

8. (Original) The frequency-offset estimator of claim 7 wherein the long training symbols are periodic having a period equal to the duration.

9. (Currently Amended) The frequency-offset estimator of claim 1 wherein further comprising;

a conjugation element to generate a complex conjugate of the training symbols;~~and first and second delay elements to delay the training symbols at least by the duration.~~

10. (Original) The frequency-offset estimator of claim 1 wherein the first autocorrelation element multiplies the training symbols with a complex conjugate of the training symbols delayed by approximately one duration, and

wherein the second autocorrelation element multiplies the symbol stream of training symbols with a complex conjugate of the symbol stream of training symbols delayed by approximately two durations.

11. (Original) The frequency-offset estimator of claim 1 wherein the first duration is a duration of one of the training symbols, and the second duration is twice the first duration, and wherein the first moving average element performs a first integration over 1.5 symbol durations and produces a first complex value, wherein the second moving average element performs a second integration over 0.5 symbol durations and produces a second complex value,

and wherein the frequency-offset estimator further comprises:

a first angular extraction element to extract the first phase shift estimate from the first complex value; and

a second angular extraction element to extract the second phase shift estimate from the second complex value.

12. (Original) The frequency-offset estimator of claim 1 wherein the frequency offset estimate is a coarse frequency offset estimate to adjust a frequency for down-converting an IF input signal to the serial symbol stream.

13. (Original) The frequency-offset estimator of claim 12 wherein the serial symbol stream is comprised of sampled short training symbols modulated on a portion of a plurality of subcarriers, the short training symbols having known training values.

14. (Currently Amended) A method for frequency synchronization of an orthogonal frequency division multiplexed (OFDM) signal comprising:

generating a frequency offset estimate using first and second phase shift estimates, the first phase shift estimate generated from a serial symbol stream of training symbols with the symbol stream delayed by approximately a first duration, the second phase shift estimate generated from the serial symbol stream with the symbol stream delayed by a second duration,
wherein the first and second phase shift estimates are generated by performing autocorrelations on differently delayed versions of the same serial symbol stream, and
wherein the first and second durations are differing integer multiples of symbol durations.

15. (Currently Amended) The method of claim 14 wherein generating comprises:

autocorrelating the serial symbol stream of training symbols with the symbol stream delayed by approximately the first duration to produce a first correlation output;

autocorrelating the serial symbol stream with the symbol stream delayed by the second duration to produce a second correlation output;

integrating the first correlation output to generate the first phase shift estimate;

integrating the second correlation output to generate the second phase shift estimate; and

combining the first and second phase shift estimates to generate the frequency offset estimate,

wherein the integrating of the first and second correlation outputs are performed over different symbol durations based respectively on the first and second durations.

16. (Original) The method of claim 15 further comprising:

rotating a phase of data symbols of an OFDM packet by applying the frequency offset estimate to a phase rotator to rotate the phase of input symbols by an amount of phase shift based on the frequency offset estimate prior to performing an FFT on the data symbols; and

holding the amount of phase shift constant for performing the FFT on the data symbols.

17. (Original) The method of claim 15 wherein the first duration is a duration of one of the training symbols, and the second duration is twice the first duration, and

wherein integrating the first correlation output includes integrating the first correlation output over approximately one and a half durations, and

wherein integrating the second correlation output includes integrating the second correlation output over approximately one-half durations.

18. (Original) The method of claim 14 further comprising adjusting the second phase shift estimate by a multiple of 2π when a difference between the first and second phase shift estimates exceed π .

19. (Currently Amended) A method for frequency synchronization of an orthogonal frequency division multiplexed (OFDM) signal comprising:

generating a frequency offset estimate using first and second phase shift estimates, the first phase shift estimate generated from a serial symbol stream of training symbols with the symbol stream delayed by approximately a first duration, the second phase shift estimate generated from the serial symbol stream with the symbol stream delayed by a second duration,

wherein generating comprises:

autocorrelating the serial symbol stream of training symbols with the symbol stream delayed by approximately the first duration to produce a first correlation output;

autocorrelating the serial symbol stream with the symbol stream delayed by the second duration to produce a second correlation output;

integrating the first correlation output to generate the first phase shift estimate;

integrating the second correlation output to generate the second phase shift estimate; and
combining the first and second phase shift estimates to generate the frequency offset
estimate, and

~~The method of claim 15~~ wherein combining includes multiplying the first phase shift estimate by $w_1/2\pi T$ to generate a first weighted frequency estimate; multiplying the second phase shift estimate by $w_2/4\pi T$ to generate a second weighted frequency estimate; and summing the first and second weighted frequency estimate to generate the frequency offset estimate, wherein w_1 and w_2 are weights and T is the duration.

20. (Original) The method of claim 14 wherein the training symbols are sampled long training symbols comprised of a plurality of modulated subcarriers having known training values.

21. (Original) The method of claim 14 further comprising:
generating a complex conjugate of the training symbols; and
delaying the training symbols at least by the duration.

22. (Currently Amended) An orthogonal frequency division multiplexed (OFDM) receiver system comprising:

a dipole antenna to receive signals that include an OFDM packet;
an RF receive unit to convert the OFDM packet to a stream of symbols;
a data symbol processing unit to perform a Fast Fourier Transform (FFT) on the stream of symbols to generate a decoded bit stream; and
a parallel-channel ~~two-channel~~ frequency offset estimator to generate a frequency offset estimate using training symbols of the stream of symbols to rotate a phase of data symbols of the OFDM packet prior to performing the FFT,
wherein the parallel-channel frequency-offset estimator comprises:
a first autocorrelation element to perform a first autocorrelation on a serial symbol stream
of training symbols delayed by a first duration to produce a first correlation output;

a second autocorrelation element to perform a second autocorrelation on the serial symbol stream delayed by a second duration to produce a second correlation output;
a first moving average element to perform a first moving average on the first correlation output for use in generating a first phase shift estimate; and
a second moving average element to perform a second moving average on the second correlation output for use in generating a second phase shift estimate,
wherein the autocorrelation elements perform autocorrelations on differently delayed versions of the same serial symbol stream, and
wherein the first and second durations are differing integer multiples of symbol durations,
and
wherein the first and second moving averages are different and based on the first and second durations, respectively.

23. (Currently Amended) The OFDM receiver system of claim 22 wherein the data symbol processing unit includes a phase rotator responsive to the frequency offset estimate, and wherein the two-channel frequency offset estimator further comprises ~~includes~~:

~~a first autocorrelation element to perform a first autocorrelation on a symbol stream of training symbols delayed by a first duration to produce a first correlation output;~~
~~a second autocorrelation element to perform a second autocorrelation on the symbol stream of training symbols delayed by a second duration to produce a second correlation output;~~
~~a first moving average element to perform a first moving average on the first correlation output for use in generating a first phase shift estimate;~~
~~a second moving average element to perform a second moving average on the second correlation output for use in generating a second phase shift estimate; and~~
a summator to combine the first and second phase shift estimates to generate the frequency offset estimate.

24. (Original) The OFDM receiver system of claim 23 wherein the first duration is a duration of one of the training symbols, and the second duration is twice the first duration, and wherein the first moving average element performs the first moving average over approximately

one and a half durations, and the second moving average element performs the second moving average over approximately one-half durations on the second correlation output.

25. (Original) The OFDM receiver system of claim 23 wherein the data symbol processing unit further includes a phase correction element to adjust the second phase shift estimate by a multiple of 2π when a difference between the first and second phase shift estimates exceed π .

26. (Currently Amended) An orthogonal frequency division multiplexed (OFDM) receiver system comprising:

a dipole antenna to receive signals that include an OFDM packet;

an RF receive unit to convert the OFDM packet to a stream of symbols;

a data symbol processing unit to perform a Fast Fourier Transform (FFT) on the stream of symbols to generate a decoded bit stream; and

a two-channel frequency offset estimator to generate a frequency offset estimate using training symbols of the stream of symbols to rotate a phase of data symbols of the OFDM packet prior to performing the FFT,

wherein the data symbol processing unit includes a phase rotator responsive to the frequency offset estimate, and wherein the two-channel frequency offset estimator includes:

a first autocorrelation element to perform a first autocorrelation on a symbol stream of training symbols delayed by a first duration to produce a first correlation output;

a second autocorrelation element to perform a second autocorrelation on the symbol stream of training symbols delayed by a second duration to produce a second correlation output;

a first moving average element to perform a first moving average on the first correlation output for use in generating a first phase shift estimate;

a second moving average element to perform a second moving average on the second correlation output for use in generating a second phase shift estimate; and

a summator to combine the first and second phase shift estimates to generate the frequency offset estimate, and

~~The OFDM receiver system of claim 23~~ wherein the summator multiplies the first phase shift estimate by $w_1/2\pi T$ to generate a first weighted frequency estimate, and multiplies the second phase shift estimate by $w_2/4\pi T$ to generate a second weighted frequency estimate, and combines the first and second weighted frequency estimates to generate the frequency offset estimate, wherein w_1 and w_2 are weights and T is the duration.

27. (Currently Amended) An article comprising a storage medium having stored thereon instructions, that when executed by a computing platform, result in:

autocorrelating a serial symbol stream of training symbols with the symbol stream delayed by approximately a first duration to produce a first correlation output;

autocorrelating the serial symbol stream with the symbol stream delayed by a second duration to produce a second correlation output;

integrating the first correlation output to generate a first phase shift estimate;

integrating the second correlation output to generate a second phase shift estimate; and

combining the first and second phase shift estimates to generate a frequency offset estimate,

wherein the autocorrelations are performed on differently delayed versions of the same serial symbol stream,

wherein the first and second durations are differing integer multiples of symbol durations,
and

wherein integrating of the first and second correlation outputs are performed for different durations based on the first and second durations, respectively.

28. (Original) The article of claim 27 wherein the instructions further result in rotating a phase of data symbols of an orthogonal frequency division multiplexed (OFDM) packet by applying the frequency offset estimate to a phase rotator to rotate the phase of input symbols by an amount of phase shift based on the frequency offset estimate prior to performing an FFT on the data symbols.

29. (Currently Amended) The article of claim 28 ~~[[29]]~~ wherein the instructions further result in:

holding the amount of phase shift constant for performing the FFT on the data symbols,
and resulting in frequency synchronization of an orthogonal frequency division
multiplexed (OFDM) signal that includes the OFDM packet.